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EXCURSION GUIDES

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Phytogeographical Forest Excursion to North Sweden

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SECTION: PHG

Phytogeographical Forest Excursion to North Sweden.

By *Tore Arnborg.*

Introduction.

The Excursion wants to give the participants a survey of Norrland's forests, its never touched primeval forests as well as the cultivated ones; it wants to give an insight into the varying forest types in Norrland, their stand composition, vegetation unions and soils. The participants will also have the opportunity of getting acquainted with some of the other most important types of nature and of the different forms of population settlements in northern Sweden. The Excursion will start in Stockholm, lat. N 59°20′, and will end at Abisko, lat. N 68° 25′. The region covered by the Excursion belongs to the Norrlandian provinces of Gästrikland, Hälsingland, Jämtland, and Lappland.

A short summary of the forest regions, and a descriptive account of the most important forest plant associations will be given in an introductory survey.

About 15 000 years ago, the southern parts of Sweden started to appear from under the melting last inland-ice. About seven thousands years ago, the last remnants of the inland-ice disappeared from Norrland. Different periods of climate from the first melting-phases of the ice up to present times have succeeded one another and are reflected in the different eras of forest history.

More than half Sweden is covered with forests. Productive forest land amounts to 22 879 000 hectares. The Government owns about 25 per cent, the Forest Companies 25 per cent, and others about 50 per cent. These have an average accreation per year and hectare of 2,6 m^3, or about 58 500 000 m^3. Forest utilization has during the last years provided about one half of the entire income from Swedish export goods. The most important forest products for export are timber, cellulose, paper, wall-board, and carpentry products.

From a phytogeographical point of view, all the forests of the country belong to the following regions:

In North Sweden

1) The *region of conifer forests of North Sweden*, which is part of the circumpolar conifer belt, with *Pinus silvestris* and *Picea Abies* often mixed with broad-leaved trees, and subordinate forests of broad-leaved trees. Among these the most frequent are *Betula pubescens* and *B. verrucosa*, but also *Populus tremula*, *Alnus incana*, *Sorbus aucuparia*, and *Salix*-species are common.
2) The *region of sub-alpine birch forests* with predominating *Betula tortuosa*, and in the east in lower levels, occasional pine and spruce.

In South Sweden

3) The *region of conifer forests of South Sweden* is transitional to the region of the beech forests. Pine and spruce dominate in most forests. The most frequent broad-leaved trees are *Betula verrucosa* and *B. pubescens* and *Alnus glutinosa*. *Quercus petraea*, *Q. robur*, *Fraxinus excelsior*, *Ulmus glabra*, *Acer platanoides*, *Tilia cordata* and *Corylus avellana* are of some importance.
4) The *region of the beech forests* is an offset of the large Middle European region of broad-leaved forests and occupies the southernmost part of Sweden. The most important broad-leaved trees are *Fagus silvatica*, *Betula verrucosa*, *B. pubescens*, *Quercus robur*, *Q. petræa*, *Fraxinus excelsior*, *Tilia cordata*, *Carpinus betulus* and *Ulmus glabra*. Cultivated forests of spruce and pine as well as some foreign coniferous trees play an important part.

The upper limit of coniferous forests
ABISKO
MUDDUS
JÖRN
VALLSJÖ
BJURÅKER
Quercus Robur
KRAKEN
by train
by bus
by plane
The south limit of spontaneous spruce forests
200 km

The Forest Regions of North Sweden.

The region of conifer forests.

Of the total area of Swedish forests, 3/5 belong to the region of conifer forests of North Sweden, also called the oakless region. From about lat. N 60° it almost reaches the northernmost parts of the country, north of 68°. Pine and spruce together represent 80—85 per cent of all trees and are about equally common. The birches amount to about 15 per cent; *Populus tremula*, *Alnus incana*, *Sorbus aucuparia*, and a few other broad-leaved trees are of less significance.

Scattered here and there in the southern and south-eastern parts, some of the southern trees occur. In the coast district of Norrland, *Fraxinus* goes as far north as 61°30′, *Tilia* and *Acer* as far as 63°30′, and *Ulmus* has its northernmost location in Lappland at 65°00′.

Our north conifer region is directly connected with the conifer forests of northern Finland. In the west, it is without interruption connected with the Norwegian forest land, but from Mt. Fulufjället, Dalarna, in lat. 61°, to northern Jämtland, the connection is broken in several places by the mountains. Throughout the whole of Lappland, the region has a coherent upper limit towards the mountains. The conifer forests reach the 900 m level in northern Dalarna (62°); the 750 m level in southern Lappland (65°) and the 500 m level in northern Lappland (67°30′). Pine and/or spruce forests form the limit of the conifer forests.

The boundary between our two conifer regions is called the ecological Norrland limit (Sernander's *limes norrlandicus*) or the oak line. This boundary separates South Sweden from North Sweden. See for instance Du Rietz 1935, Fries 1948.

The region of sub-alpine birch forests.

Between the conifer forest and the tree limit, there is nearly everywhere along the Swedish mountain range a belt of birch forest chiefly formed by *Betula tortuosa*, but in several places also by the lowland birch, *Betula pubescens*. *Populus*, *Alnus incana*, and *Salix caprea* mix in the birch forest. Important *Salix*-species forming brushwood are, for instance, *Salix lapponum* and *S. glauca*. In the southern parts of the mountain chain, the birch forests ascend to about 950 m above sea level; in the middle parts to about 800 m; and in the northernmost parts to 700 m.

The Field and Bottom Layer Vegetation.

The North Swedish forests belong to three principal types; viz. heath forests on dry to moist and comparatively poor soils, meadow forests mostly on rather moist, very good soils, and mire forests on wet more or less peaty soils of varied quality (Alb. Nilsson 1902). A brief account will be given here of the most important one-layer communities (synusiæ) of the rank of the union (cp. Arnborg 1940, 1943, 1949 b.) I shall, however, not attempt to go into the procedure of classifying the bigger units, nor to make a subdivision of the unions.

Heath Forests.

On dry as well as on moist soil, vegetation communities of the heath forests are predominating. Approximately 80 per cent of the forested area in Norrland are covered with heath forests.

The field layer of the heath forests.

The Calluna-union usually forms a thin field layer where *Calluna vulgaris*, *Arctostaphylos uva-ursi*, and *Empetrum hermaphroditum* (towards the south *E. nigrum*) are alternatively predominating, with scattered occurrences of *Vaccinium Vitis-idaea*. Only these four species are found in the field layer of the types poorest in species. The union is found on extremely dry sand and gravel within the entire area.

The Empetrum-union forms a closed, comparatively low carpet of *Empetrum*, *Vaccinium Myrtillus*, *V. Vitis-idaea* and *Deschampsia flexuosa*. *Linnaea borealis* is found, and occasionally a few herbs: *Trientalis europaea*, *Maianthemum bifolium* and *Solidago Virgaurea* as well as *Cornus suecica* in the coast district and on higher levels in the interior. The union is common on dry soils within the entire area, in the region of the conifer forests as well as in the region of the sub-alpine birch forests.

The Vitis-idaea-union forms a closed cover in which *Vaccinium Vitis-idaea* is dominating, mixed with *Empetrum*, low *Vaccinium Myrtillus*, in the north also *Ledum palustre;* furthermore *Linnaea* and occasionally *Trientalis*, *Maianthemum*, *Melampyrum pratense*, *Solidago*, *Deschampsia flexuosa*, *Luzula pilosa*. *Calluna* may be present as well as *Lycopodium clavatum* and *L. complanatum*. The union is most common on comparatively dry soils; it is common within the region except in the mountains where it is replaced by the *Empetrum*-union.

The Myrtillus-union has as its predominant a vigorous *Vaccinium Myrtillus*. *V. Vitis-idaea* usually is subdominating. After bilberry and cowberry the most frequent dwarf-shrub is *Linnaea borealis*. *Deschampsia flexuosa* is found everywhere, often sterile; it becomes fertile in open places and grows abundantly in logged areas where the vegetation passes into the *Flexuosa*-union. *Melampyrum pratense* (less often *M. silvaticum*), *Maianthemum bifolium*, *Trientalis europaea*, *Solidago Virgaurea*, *Luzula pilosa*, *Lycopodium clavatum* and *L. annotinum* belong to the union. *Rubus idaeus* as well as *Chamaenerion angustifolium* often become prevailing in logged areas (transitions to the *Chamaenerion*-union). In moist situations also *Equisetum silvaticum*, *Vaccinium uliginosum* and *Listera cordata* are found. The *Myrtillus*-union is the com-

monest of the unions in the North conifer region and is very common also in the region of the mountain-birch. Among common variants a community rich in *Cornus suecica* can be mentioned and also a *Maianthemum*-variant in which *Maianthemum bifolium* dominates in patches.

The Flexuosa-union has as its dominating species *Deschampsia flexuosa*. *Vaccinium Myrtillus* and other dwarf-shrubs fall behind. To the union belong *Chamaenerion angustifolium*, *Solidago Virgaurea*, *Melampyrum pratense*, *Trientalis europaea* etc. The *Flexuosa*-union is the most frequent community in clear-cut areas — *Deschampsia flexuosa* is the commonest grass in the North Swedish forests — but occupies an area during a relatively short period of time, i.e. only as long as it is unwooded.

The Dryopteris-union is distinguished from the *Myrtillus*-union through the intermixture of *Lastrea Dryopteris*, which, alternating with *Vaccinium Myrtillus*, is predominant. *V. Vitis-idaea*, *Linnaea*, and *Deschampsia flexuosa* are always found. Tall meadow herbs are missing. In addition to the species of the *Myrtillus*-union, the following are common: *Oxalis Acetosella*, *Rubus saxatilis*, *Ramischia secunda*, *Pyrola minor*, *Lastrea Phegopteris*, and, in open spaces, *Chamaenerion* and *Rubus idaeus*. In moist areas *Deschampsia caespitosa*, *Equisetum silvaticum*, and *Listera cordata* usually are found. — The union is common within both regions on gently sloping moraine soil.

The Geranium-union forms a transition to the series of the meadow forests. Besides *Vaccinium Myrtillus*, *Geranium silvaticum* is always found and often prevailing; *Lactuca alpina* is common and *Aconitum septentrionale* occurs in abundance especially in certain calcareous districts. All the species of the *Dryopteris*-union also belong to this union. In variants rich in species the following additional ones may be mentioned: *Athyrium Filix-femina*, *Chamaenerion angustifolium*, *Dryopteris austriaca*, *Ranunculus acris*, *Cirsium heterophyllum*, *Trollius europaeus*, and, in moist places, *Calamagrostis purpurea* and *Filipendula Ulmaria*. In the southern parts of the region of coniferous forests, southern herbs are found, for instance *Anemone hepatica* and *Lathyrus vernus*. The *Geranium*-union occurs through the entire northern forest land but covers as a rule only small areas on spruce clad slopes as well as in the sub-alpine birch forest.

The Chamaenerion-union forms a tall cover in clear-cut areas with *Chamaenerion angustifolium* as its dominant. In addition there is plenty of *Deschampsia flexuosa* and often also *Rubus idaeus*, in the south *Calamagrostis arundinacea* and *Pteridium aquilinum*, in moist areas *Deschampsia caespitosa*.

The bottom layer of the heath forests.

The Cladonia-union usually forms a closed bottom layer, the two most important species of which, *Cladonia rangiferina* and *Cl. silvatica*, are often replaced by *Cl. alpestris* and *Stereocaulon paschale*. Among the other *Cladonia*-species can be mentioned: *Cl. deformis*, *Cl. pyxidata*, *Cl. uncialis*, *Cl. gracilis* var. *chordalis*, *Cl. verticillata*, *Cl. crispata*. *Cetraria islandica* is common; *Solorina crocea* is often found intermixed. Mosses occur sparsely, for instance *Polytrichum piliferum* and *P. juniperinum*, *Dicranum fuscescens*, rarely *Pleurozium Schreberi*. The *Cladonia*-union is common in extremely dry, sandy areas in the region of the coniferous forests; together with the *Calluna*-union it constitutes the vegetation community of the pine-lichen heaths proper.

The Pleurozium-union is an intermediate type between the *Cladonia*-union and the *Hylocomium*-union, a lichen-moss-community. In the union all the *Cladonia*-species of the preceding union are found, with *Cl. rangiferina* and *Cl. silvatica* as the most important and predominating in spots. *Cetraria islandica* is common as well as *Nephroma arcticum* and *Peltigera aphthosa*. *Pleurozium Schreberi* is most frequent among the mosses; *Dicranum fuscescens*, *Polytrichum juniperinum* and *Orthocaulis Floerkei* belong to the union. *Hylocomium splendens* does only occur occasionally; *Ptilium crista-castrensis* does not at all belong to this union. The *Pleurozium*-union is very common within the two regions of North Swedish forests, covering dry sand and moraine soils, in conifer region often with a tree layer of pine. It is as a rule combined with the *Empetrum*-union and the *Vitis-idaea*-union, but only rarely with the *Calluna*-union.

The Hylocomium-union is formed by the two commonest mosses of the North Swedish forests, viz. *Pleurozium Schreberi* and *Hylocomium splendens*. Together with these, *Ptilium crista-castrensis* is often found; it is a differential species against the *Pleurozium*-union. In addition to these three species, the following are found; *Dicranum majus*, *D. fusce-*

scens and *D. scoparium*, Norrland's most common forest liverwort *Barbilophozia lycopodioides*, and often *Orthocaulis Floerkei*. Occasional lichens occur, for instance, *Cladonia rangiferina* and *Cl. silvatica*, *Cl. furcata*, *Cetraria islandica*, *Nephroma arcticum*, *Peltigera aphthosa*. The *Hylocomium*-union is the commonest bottom layer union in the north Swedish forests, occurring in less dry areas within the entire district. It is usually combined with the *Myrtillus*-union, and seldom with the *Dryopteris*-union.

The Triquetrus-union has as its regular predominating species *Rhytidiadelphus triquetrus*, but in addition to the three most frequent mosses of the preceding union, the following, may among others, dominate locally, viz. *Hylocomium umbratum*, *H. pyrenaicum*, *Rhodobryum roseum*, *Brachythecium salebrosum*, and in the south *Mnium undulatum* and *Plagiochila asplenioides*. The *Triquetrus*-union is found here and there in areas rich in nutrients. In the heath forest series it is very often combined with the *Geranium*-union but also with the *Dryopteris*-union and besides with some of the unions in the meadow forest series.

The Polytrichum-union consists of *Polytrichum commune* and as a rule of species of *Sphagnum*. Among these, *Sphagnum robustum* and *S. Girgensohnii* are most frequent; *S. nemoreum* and *S. parvifolium* are also common; and in transitions to the forests on wet peat-soils, among others, *S. riparium*, *S. centrale*, and *S. subtile;* further, for instance, *Aulacomnium palustre* and some species of *Mnium*. The *Polytrichum*-union is common in moist areas within the entire North Swedish forest land. Among the variants a *Sphagnum robustum* - variant can be distinguished, which is common in combination with the *Myrtillus*-union, a *Sphagnum Girgensohnii* - variant, which is more often combined with the *Dryopteris*- and the *Geranium*-unions, and a pure *Polytrichum commune*-type combined with the *Vitis-idaea*-union and free of peat-moss, on soils rich in fine material. Then *Polytrichum commune* (the tallest of Scandinavias terrestrial mosses) becomes 50—60 cm long and forms 30 cm thick, very dense carpets.

Meadow Forests.

On slopes with an ample supply of water and preferably with soils originating from rocks not too poor in nutrients, a

tall meadow vegetation often is prevailing. All along the Scandinavian mountain range splendid meadow forests are found in many places, in the region of the sub-alpine birch forests as well as in the region of coniferous forests. Scattered occurrences are found in other parts of the forest land, especially on limestone moraines and on fine sediments along water courses, and in areas now or formerly used for mowing and grazing. The chief unions only will be mentioned.

The field layer of the meadow forests.

The Lactuca-union is the commonest among the unions of the meadow forests. *Lactuca alpina* is often replaced by *Geranium silvaticum*. To the union belong among others: *Chamaenerion angustifolium*,*Cirsium heterophyllum*, *Convallaria majalis*, *Maianthemum bifolium*, *Melampyrum pratense*, *M. silvaticum*, *Oxalis Acetosella*, *Paris quadrifolia*, *Ranunculus acris*, *Rubus saxatilis*, *Solidago Virgaurea*, *Taraxacum croceum*, *Trollius europaeus*, *Lastrea Dryopteris*, *L. Phegopteris*, *Dryopteris austriaca*, *Athyrium Filix-femina*, *Agrostis tenuis*, *Deschampsia caespitosa*, *Melica nutans* and *Milium effusum*. The *Lactuca*-union is found from about lat. 60°, the whole distance northwards along the mountain range, and in scattered localities below the mountains.

The Aconitum-union has, in addition to *Aconitum septentrionale*, all the species of the *Lactuca*-union. It is richer in species and has a taller growth. *Aconitum* is often predominating in very dense stands where this herb, one of the tallest in Scandinavia, often reaches a man's height, not unfrequently 2 m. To an inferior layer belong, for example, *Viola biflora*, *Melampyrum silvaticum*, *Stellaria nemorum*, *Anemone nemorosa* and *Polygonum viriparum*. In large areas, *Lactuca alpina* alternates as a dominant, in other areas the vegetation is formed by, for instance, *Chamaenerion*, *Rumex Acetosa* ssp. *lapponicus*, *Trollius europaeus* and *Melandrium dioecum*. A variant on moist soil has as predominants tall ferns, among which the beautiful, cornet-shaped *Matteuccia Struthiopteris* is particularly noteworthy reaching man's height, too. Where humidity is higher, *Filipendula Ulmaria*, *Corallorhiza trifida*, *Crepis paludosa*, *Petasites frigidus*, *Epilobium Hornemanni*, *Caltha pa-*

lustris, *Equisetum silvaticum* and *E. pratense* occur. The *Aconitum*-union belongs above all to the slopes, often rich in lime, in the mountain areas from about 63° 30′ to 67° 30′. It is also found in the Cambro-Silurian foreland of Central Jämtland and in places farther east. — Maps of the distribution of *Lactuca alpina* and *Aconitum septentrionale* in Fries 1949.

The bottom layer of the meadow forests.

The Brachythecium-union most frequently forms a sparse bottom layer in which are found in addition to *Brachythecium salebrosum* several other species of this genus, for instance *B. reflexum*, *B. Starkei*, and *B. velutinum*. To the union belong furthermore *Hylocomium splendens*, sometimes *Pleurozium Schreberi*, *Rhythidiadelphus triquetrus*, *Rhodobryum roseum*, *Plagiothecium denticulatum*, *Dicranum*-species, and some *Mnium*-species, for instance *M. punctatum*. Of liverworts there are among others, *Barbilophozia barbata*, *Leiocolea obtusa* and *Orthocaulis Kunzeanus*. The *Brachythecium*-union belongs to the dry to moist soils with *Betula pubescens* and *Alnus incana* in the spruce forest, where it is combined with the *Lactuca*-union and the *Aconitum*-union and sometimes with the *Geranium*-union.

The Mnium-union with patches with a high degree of cover is formed by *Mnium cinclidioides* mixed with *M. punctatum*, *M. pseudopunctatum*, *M. rugicum*, *Aulacomnium palustre*, *Drepanocladus uncinatus*, *Scapania paludosa*, *Tritomaria quinquedentata*, *Bryum Duvalii*, and *Climacium dendroides*, and includes most of the species belonging to the *Brachythecium*-union. Occasional *Sphagnum* is found, as *S. Girgensohnii* and *S. robustum*. The *Mnium*-union belongs above all to the moist soils with meadow herb forests and is richest in species in connection with the variant of the *Aconitum*-union which is at home in moist areas. The union is also found on wet peaty areas with forests of broad-leaved trees.

Mire Forests.

In very wet areas forest associations of different kinds are formed according to differences in soil reaction and in the supply of available nutrients.

The field layer of the mire forests.

The Globularis-union is characterized by a rich dwarf-shrub vegetation of *Vaccinium Myrtillus, V. uliginosum, V. Vitis-idaea*, often also *Ledum palustre, Linnaea borealis, Andromeda polifolia, Oxycoccus microcarpus, Q. quadripetalus, Calluna vulgaris* and *Empetrum. Betula nana* often is plentiful. *Carex globularis* is not found constantly but is dominating here and there in tufts or in bigger patches. *Rubus Chamaemorus* belongs to the union as well as *Melampyrum pratense; Deschampsia flexuosa* and *Eriophorum vaginatum* occur occasionally as well as low-growing *Equisetum silvaticum*. The *Globularis*-union is common in the transition from heath forest to the bogs. The distribution is eastern, and does not reach the mountain range except at a few points.

The Chamaemorus-union differs from the preceding union by the facts that *Rubus Chamaemorus* is generally dominating and fertil here and that grasses occur more frequently; especially *Deschampsia flexuosa. Listera cordata* and *Ramischia secunda* can be mentioned as belonging to the union. The *Chamaemorus*-union is common in swampy spruce forests mixed with birch in all parts of the region of conifer forests.

The Equisetum-union is dominated by *Equisetum silvaticum. E. pratense* is found, *Lastrea Dryopteris* and not seldom *Oxalis Acetosella* and *Melampyrum pratense*, more sparsely *Potentilla palustris. Calamagrostis purpurea* is common as well as *Deschampsia caespitosa*, but also *D. flexuosa* and *Carex globularis* are often found. *Vaccinium Myrtillus, V. Vitis-idaea*, and *V. uliginosum* occasionally occur on the hummocks, as well as *Ledum palustre* and *Rubus Chamaemorus.* The *Equisetum*-union is found here and there in very moist moraine areas or on horizontal fine-grained soils, as a rule in spruce forests showing a tendency of becoming swampy.

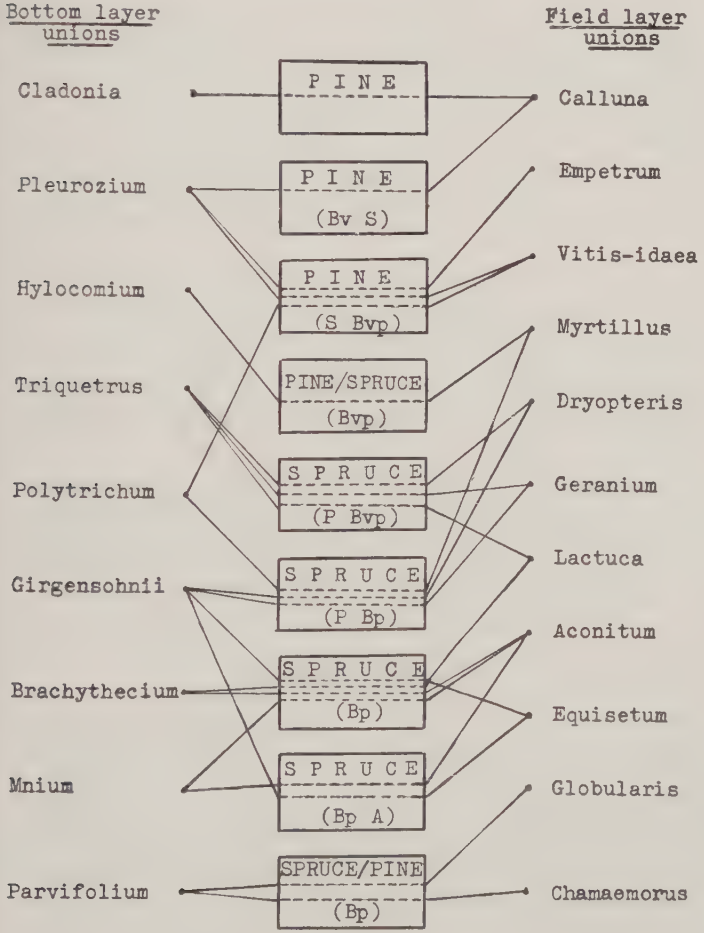
The Ulmaria-union is a heterogenous union very rich in species, in which *Filipendula Ulmaria* is always found but only rarely is dominating except in open places. Among the herbs are *Lactuca alpina, Valeriana sambucifolia, Alchemilla glomerulans, Parnassia palustris, Selaginella Selaginoides, Epilobium Hornemanni, Caltha palustris, Petasites frigidus.* Especially remarkable in upper Norrland are the characteristic tussocks of *Carex juncella;* common are *C. vaginata, C. canescens, C. magellanica*, sometimes *C. loliacea* and *Eriophorum angustifolium. Deschampsia*

The most common combinations of field and bottom layer unions in conifer forests of North Sweden and their dominant and subdominant (in parenthesis) trees.

P: Pine (Pinus silvestris) S: Spruce (Picea Abies)

B: Birch (Betula), v: B. verrucosa, p: B. pubescens

A: Gray alder (Alnus incana)



caespitosa is one of the most important grasses together with *Calamagrostis purpurea*. The *Ulmaria*-union is found here and there in moist and wet places along brooks and rivers. The tree layer usually is a *Betula pubescens - Alnus incana* forest with spruce. A shrub layer of willows is often present.

The bottom layer of the mire forests.

The Parvifolium-union is composed by *Sphagnum parvifolium*, *S. robustum*, *S. angustifolium* and in hummocks *S. fuscum*, *Pleurozium Schreberi*, *Dicranum Bergeri*, *Aulacomnium palustre*, *Mylia anomala*, and *Polytrichum strictum*, often accompanied by *Cladonia rangiferina* and *Cl. silvatica*. The *Parvifolium*-union is common in the swampy forest on poor soil, where spruce, pine and *Betula pubescens* form a thin forest in combination with the *Globularis*- and the *Chamaemorus*-unions.

The Girgensohnii-union has a cover of peat-moss, in which *S. Girgensohnii* is often dominating, in spots replaced by *S. robustum*, *S. parvifolium*, *S. riparium* or *S. squarrosum*. *Polytrichum commune* is frequently dominating. The *Girgensohnii*-union is common in combination with the *Equisetum*-union and not unfrequently also found together with the *Dryopteris*-union. The forest generally is a spruce forest mixed with *Betula pubescens*.

In forests on peat soils often rich in nutrients, where the meadow herbs are dominating, namely in forests with a field layer belonging to the *Ulmaria*-union or the *Aconitum*-union, the bottom layer belongs to the *Mnium*-union. In this is then often found, for instance, *Paludella squarrosa*, *Philonotis fontana* and other mosses common in springs.

Excursion Schedule.

Friday, 21st July.

From Stockholm by train to Storvik. By autocar to Kratte Masugn in Torsåker (60°30′) in Gästrikland. — Stockholm is situated in the Mälar Valley which has a comparatively mild climate and is rich in broad-leaved forests. The coniferous forests, however, dominate the scenery, and the railway to

Uppsala passes through some large forests of pine (*Pinus silvestris*) and spruce (*Picea Abies*) the two species of trees which will be predominating during nearly the entire journey.

Beyond Uppsala the railway runs west to Krylbo through alternating coniferous forests and cultivations. We now cross the river Dalälven and after a little while reach Storvik in Gästrikland, the southernmost province of Norrland. — A short trip takes us to Kratte Masugn. Here we are in the transition zone between South and North Sweden, in the neighbourhood of the natural southern boundary of North Sweden, the "*limes norrlandicus*" which is one of the country's most important phytogeographical boundaries.

Saturday 22nd July.

Kratte Masugn belongs to the Forestry Board of Gävleborg District (the provinces of Gästrikland and Hälsingland), which has here a forestry estate, chiefly for the instruction in silviculture of the farming people. Already in 1374 and again in 1464, the inhabitants of the parish Torsåker were given the privelege of mining. A forge was established early at Kratten, and in the 1670-ties, a smelting house was built, too. Charcoal was obtainable from the woods. In spite of the forest having been subject to extensive logging, the supply of timber was plentiful and in 1894 a saw mill was erected at Kratten. The forests now are comparatively young, grown up after logging around the shift of the century and also to a large extent grown on abandoned arable land.

In this hilly country, the bedrock is often exposed: gneiss-granites, in many places with amphibolites which are of great importance for the fertility of the ground; leptites, a very old type of rock sometimes with ores and primary limestone.

After the release from the inland-ice, the shore-line was

204 m above the present sea level. Part of the district, the hill Kopparåsen, then was an island in the sea. The loose deposits around the rocky grounds consist of bouldery moraine gravel; further down are sediments, of sand, here and there passing into clay.

The forests are chiefly formed by pine and spruce, but broad-leaved trees such as birch, aspen and alder occupy big areas. Pure pine forest dominates only in a few places with exposed rocks. Young pine stands occur here and there, but on the whole, the woods in the Kratte district are composed of mixed stands of pine and spruce, where spruce grows just as well as pine, or even better on the best soils. The birch has as a settler entered upon areas formerly burnt for making charcoal, and on disused arable fields. In moist depressions *Betula pubescens* is dominating, in dry areas *B. verrucosa* grows faster, but as a rule is of inferior quality. *Populus tremula* occurs here and there, in groups after vegetative reproduction. In areas more rich in nutrients, previously fields and meadows, *Alnus glutinosa* grows, in old mire cultivations also *Alnus incana*. *Sorbus aucuparia* is common but does not, however, form stands. *Acer* appears spontaneously; *Fraxinus* seedlings in some places originate from planted trees. *Corylus avellana*, too, was very likely introduced by man. Oak is missing as we are now somewhat to the northwest of the natural boundary between North and South Sweden.

In the thin pine forests, a vegetation-union consisting of dwarf-shrubs and lichens prevails: The *Vitis-idaea*-union in combination with the *Cladonia*-union, in spots with *Calluna vulgaris* and *Sphagnum nemoreum* which often grows on bare rock. In less dry areas where spruce and pine form the tree layer, also *Vaccinium Vitis-idaea* is frequently predominating, but together with mosses among which *Pleurozium Schreberi*

is the most common. In areas with somewhat higher humidity, the *Myrtillus*-union prevails together with the *Pleurozium*- or the *Hylocomium*-union. In areas richer in nutrients and on slopes with subsoil water rich in oxygen, herbs are common among the dwarf-shrubs and form societies together with *Vaccinium Myrtillus*, *Oxalis Acetosella*, *Anemone nemorosa* and *Geranium silvaticum*. This vegetation belongs to the *Geranium*-union. In open spaces in the forest grass abunds, in the first place *Calamagrostis arundinacea* and *Deschampsia flexuosa*, both typical of logged areas. Pure herb communities are common in some parts, chiefly *Anemone-Oxalis*-communities. In the damp and moist areas *Filipendula Ulmaria* and *Cirsium heterophyllum* are found along with *Sphagnum*, *Mnium*, *Rhodobryum roseum* and other mosses of moist soil. Here *Deschampsia caespitosa* is the commonest grass.

The Kratte forest is greatly influenced by man and lacks all features of a primeval forest. The forest types, characterized by the communities of the field and bottom layer, are on the whole more or less typical of south Norrland.

From Kratte Masugn by bus to Storvik and from there by train to Ljusdal.

Our road through Gästrikland traverses a region of conifer forests of northern Swedish type with heathy pine and spruce woodlands, and here and there through minor agricultural districts. The railway runs about 100 m above sea level across small rivers and past little lakes. At Kilafors in Hälsingland we meet the Ljusnan river with its many extensions similar to lakes. From Bollnäs the railway follows this river all the way to Ljusdal. The country becomes more elevated, with many forest-clad mountain tops reaching 400 m above sea level. The forests trees are pine or spruce, and almost everywhere mixed with birch. No southern broad-leaved species can be discovered

now with the exception of some occasional planted maples, ashes and elms around the buildings. Among the houses there are many big, old timber buildings reminding of times when timber was a cheap building material.

Ljusdal is an old village, now a small country town, on the Ljusnan, and situated on river sediments where in old times the sea formed a bay. The highest shore line here is approximately 235 m above sea level.

Sunday, 23rd July.

Bus trip through forest districts in northern Hälsingland (62°). Route: Ljusdal—Västansjö—Friggesund—Hedvigsfors—Frisbo—Strömbacka—Moviken—Ljusdal. The forests we intend to visit are located to the north of Hälsinglands largest lakes, Dellensjöarna, which are separated by a neck of land, the low Norrbonäset, and are situated on the 42 m level. The environs show a variety of scenery, from the extensively cultivated low lands at Delsbo to the very hilly forest-clad areas to the south and north of the lakes. Also to the east of the lake complex, the landscape is broken by a few hills reaching about 300 m above the surface of the lake, and to the northwest of Lake North Dellen there are hills reaching 425 m above sea level.

The bedrock consists of a gneiss-granite, but parts of the bottom of the lake, the soil-covered Norrbonäset and some small islets in the north lake consist of a kind of rock of volcanic origin. The "Dellenite" which has derived its name from the lakes, is a young kind of rock which evidently fills a broad crevice in the Archaean rock. Thus, the site of the Dellen lakes is an old crater lake.

The highest shore line is found in the neighbourhood of Strömbacka at approximately 247 m above sea level. Below

this line there are washed-out moraines, rich in boulders, water-assorted gravel, lake sand and clay; above the line, ground moraine, and in several places peat soils, prevail.

The Dellen lakes have a smoothing influence on the temperature. The annual temperature at Bjuråker (on the 72 m level) is + 3.25° C, the average in July, + 15° C, and in January, —7.1° C. The smaller lakes in the district freeze on the 10—12th November, whereas the Dellen lakes are frozen over on the 10—15th December. The breaking up of the ice occurs at about the same time for all the lakes, in the first week in May. At Bjuråker the precipitation is 469 mm, at Strömbacka (on the 160 m level) 659 mm.

The forest areas to the north of the Dellen lakes are more varying than in most other parts of Norrland. Particularly remarkable is the frequent occurrence of bilberry spruce forests rich in meadow herbs. In few places — if any — in Norrland are there such large continuous spruce forests rich in herbs and ferns as in the Strömbacka district.

On somewhat moist soils we thus find in many place a very luxuriant vegetation. Predominating communities are the *Dryopteris-* and *Geranium*-unions, above all combined with the *Triquetrus*-union.

Vaccinium Myrtillus is present everywhere but never prevails among these pure meadow-herb-types. In areas less rich in herbs, dwarf-shrubs, above all bilberry, are predominating. Herbs are still frequent and *Lastrea Dryopteris* is dominating in many parts. Common to all areas rich in herbs are the frequent *Sorbus*-shoots. Everywhere small rowan plants are found, sometimes seedlings, but mostly slips and stump sprouts from plants which are often as old as the 150 year old spruce forest.

Nearly all areas now covered with spruce forests along the road from Hedvigsfors to Strömbacka were formerly burnt

over for crops, or logged for charcoal. According to an ancient custom in many parts of Norrland, until only about 100 years ago, the forests were cut and burnt, and rye, turnips, or oats were sowed in the ashes. In this district clearing and burning of forest land for crops flourished after the big immigration of Finns about 300 years ago. After one or two harvests, the burnt-over areas were lying fallow as pasturages and soon became overgrown. At first there was a young forest consisting of birch with pine and spruce where new spruce gradually came up under the dense overwood. The birches were crowded out and 150 years after the burning the forest was an uneven-aged spruce forest with scattered old pines. In the same way areas where wood was cut for charcoal and burnt became reforested.

In this way these old spruce forests are more or less products of culture. They belong to Iggesunds Bruk Co. At Hedvigsfors we shall have the opportunity of seeing a pine forest reserve having acquired the character of primeval forest.

Monday, 24th July.

By bus from Ljusdal via Ramsjö -Östavall -Ånge—Bräcke —Östersund -Strömsund —Alanäs—Gäddede to Jorm.

Along the road to the north-western corner of Hälsingland pine and spruce woods alternate generally with high cubic contents and of good quality. At Juvatsdammen we shall cross the boundary to Medelpad and after Ånge we reach large spruce forest areas around the boundary to Jämtland. For the first time, we shall here meet one of the most imposing plants of the Scandinavian forest with meadow herbs, *Aconitum septentionale* (at Jämtkrogen). We approach the western Cambro-Silurian district. After Bräcke there will be a stop at a pine stand of extraordinarily fine type, a plus stand, thinned

for the purpose of producing a (phenotypically) very good stand for collecting cones by aid of ladders. The road continues along the lake Revsundssjön via Brunflo to Östersund, the only city in Jämtland.

In the afternoon the route traverses the big forest and mire districts of the Cambro-Silurian region. See SJÖRS, page 31.

We arrive at Strömsund at "Ström's Vattudal" (literally: "water valley"), a system of lakes, which is followed towards the mountains until we pass Gäddede and reach Jorm. On the slope facing the south of Mt. Fågelberget, a southern tree, *Ulmus glabra* subsp. *montana* forms a relic stand. At Bågede one of our companions from the very start, *Betula verrucosa*, leaves off; at Gäddede the last spontaneous pines are observed.

Tuesday, 25th July.

The Jorm district (64°45′). Quarters at Jormlien. Day of rest.

Jorm is situated 350 m above sea level and only 15 km from the Norwegian border. The highest mountains here reach about 1 200 m above sea level. The climate is influenced by the proximity to the Atlantic Ocean. Precipitation is relatively high, in Jorm approximately 800 mm, the snow cover remains a long time — from the end of October to the end of May — and the snow often covers the soil before it has time to freeze. The temperature is for January −8.6° C, for July +12° C. The rock consists of Cambro-Silurian schists.

The forests next to Jormlien are spruce forests mixed with birch alternating between heath type rich in herbs and meadow herb type.

Wednesday, 26th July.

By bus northwards to the lake Ankarvattnet, where the road ends at three small farms.

The forest reserve at Ankarvattnet. An untouched forest area of about 25 hectares here is preserved by the Kungsgården-Marieberg Co. as a reservation which stretches from the road 450 m above sea level to about 550 m. On this slope facing east, a sparse but luxuriant meadow birch forest grows, with gray alder, sallow, rowan and occasionally spruce, and here and there dense-stand-forming bird cherry trees.

On the slope the birches (*B. pubescens*) are up to 10—12 m high; most of them are bent stump sprouts of crooked growth. The stoutest birches have a diameter of 30—40 cm at breast height and are two hundred years old with a dark, and, at the base, rough bark. Occasional glossy "gray-birches" are found as well as some "flarn-birches." The gray alder also reaches the height of 12 m and occasionally has a diameter of 25—30 cm. *Salix caprea* is straight-stemmed, maximum height 8—12 m and diameter, 20—25 cm. *Sorbus aucuparia* does not attain the same dimensions but generally has an even and straight stem. *Prunus padus* is often tall but is weak and unable to resist the snow pressure. It lies down and forms a dense brushwood.

Common for all these trees are their mode of rejuvenation through stump sprouts. When a stem starts getting diseased, the first sprouts appear and when it has become decayed inside and has toppled over the stump sprouts shoot up and the individual goes on living — theoretically it can keep alive any length of time and there are perhaps individuals a thousand years or more old. Spruce occurs here and there, mostly 200 years old or more. The spruce shows good growth — the largest trees have a diameter of 40—50 cm. The propagation of the spruce through seedlings is insignificant. Vegetation is too dense. Only a couple of seedling growing on mouldering wood have been found.

Predominating meadow herbs are *Lactuca alpina* and *Aconitum septentrionale:* the field layer union is the *Aconitum*-union. Below the densest groups of trees, the field layer gets thinner but is still closed. Ferns play an important part in some places. Small ferns are found almost everywhere. Big ferns form dense tufts here and there. In the lower, moist part *Matteuccia Struthiopteris* is dominating. On the top plateaus there is dwarf-shrub vegetation (the *Myrtillus*- and *Dryopteris*-unions) with biilberry, *Empetrum*, *Dryopteris* in spots, and vast moist areas with *Polytrichum* and *Sphagnum*.

This meadow birch forest represents a probably very stable type of forest. In these very fertile areas the *Betula pubescens* forest is the climax association. The birches and the other broad-leaved trees propagate through stump sprouts. The growth of all tree seedlings is checked by a thriving field layer with all its litter.

From the point of view of forestry the good areas are not utilized in a rational way. Spruce is now being planted here, on an experimental basis, under a thinned-out screen and in open places. If, during the first few years, the plants are given help through eradicating herbs etc. around them, they will thrive, and in the future perhaps productive spruce forests will replace the beautiful, natural birch forests.

Thursday, 27th July.

By bus from Jorm via Gäddede and Alanäs to Hoting.

Burnt logged areas, now planted and sowed, will be demonstrated. In large districts of the inner of Norrland the humus cover is very thick and only by means of burning does soil condition become better for the regeneration. As a rule cultivation must be made in these old spruce areas where natural regeneration requires too long time because of lack of seeds

and too low germination temperature. The latter cause makes sowing more difficult than planting, and above the 400 m level, sowing is not advisable. Great areas are burnt every year. For instance, at Storvattnet, to the east of Gäddede, an area of 325 hectares was burnt in 1948. On the other hand, natural forest fires have had little importance in western Jämtland. Perhaps this is one reason why pine and *Betula verrucosa* are so sparse and altogether missing over vast areas. In the cultivations pine is often found and is apparently thriving.

The mountain Fågelberget with its *Ulmus*-relic will be visited.

Stops will be made in different forest types, viz. a pine forest in a dry area with the *Vitis-idaea*-union and lichens dominating in spots, spruce forests with the *Myrtillus*-union, and a spruce forest rich in herbs in a moist area with *Aconitum* and dwarf-shrubs above a bottom layer of *Mnium*-species.

The boundary to Ångermanland is reached immediately after Lake Flåsjön, and we shall arrive at Hoting.

Friday, 28th July.

The Vallsjö forest (64°20′). An easily accessible forest reservation, 5 km to the west of Dorotea in Lappland will be visited. A forest section, 85 hectares in size, belonging to the Kramfors Co., has been set aside. A ridge of Revsund granite runs through the forest and reaches the height of 424 m above sea level. On the slope down to a small tarn, a dense spruce forest grows. The tarn is surrounded by mire. The varying topography and the many different soils from rock to peat, contribute to make the vegetation very varied, and a great number of communities will be found here concentrated to a small area. The most important are described below. For other particulars, see "Der Vallsjö-Wald, ein nordschwedischer Urwald" (Arnborg 1940).

The forest on rock substratum has a sparse stand of slow-growing pines up to 200 years old, and a mosaic of *Cladonia*-species, *Stereocaulon paschale*, *Dicranum fuscescens*, *Rhacomitrium microcarpon*, etc. The field layer consists of *Vaccinium Vitis-idaea* and *Empetrum hermaphroditum* in the dry spots, while *Vaccinium Myrtillus* and *Pleurozium Schreberi* grow in less dry places. *Calluna vulgaris* occurs here and there, in the moistest hollows also *Vaccinium uliginosum*.

A lower section of the hill has a moraine cover on top of the rock. The forest here is a mixed pine and spruce forest. The field layer belongs to the *Empetrum*-union, the bottom layer to the *Pleurozium*-union. Grasses and herbs are scarce.

The spruce forest on the slope below the hill shows 25—30 m high, approximately 185 years old spruces. The trees are covered with lichens such as *Alectoria jubata*, *A. sarmentosa*, *Lobaria pulmonaria*, and *L. scrobiculata*. Predominating communities are the *Myrtillus*-union together with the *Hylocomium*-union. *Deschampsia flexuosa* is found everywhere and is, like *Trientalis europaea*, plentiful in open spaces. *Linnaea borealis*, *Melampyrum pratense* and *Maianthemum bifolium* are common. Certain sections are largely intermixed with *Lastrea Dryopteris*, which is a differential species between the *Dryopteris*-union and the above-mentioned field layer union together with among others *Oxalis Acetosella* and *Melampyrum silvaticum*. The bottom layer belongs to the same union as before, the *Hylocomium*-union. On the same soils in the spruce forest, herbs such as *Geranium silvaticum* and *Lactuca alpina* grow, together with the dwarf-shrubs belonging to the *Geranium*-union. In moister areas we find the same field layer but the bottom layer belongs to the *Polytrichum*-union instead.

The spruce - birch - gray alder wood at the tarn shows a multitude of communities, where among others the following

species are prominent: *Rubus Chamaemorus, Sphagnum angustifolium, Sphagnum robustum.*

The mire has banks and islands with *Sphagnum fuscum, S. magellanicum, S. plumulosum, Scirpus caespitosus, Andromeda polifolia* and *Rubus Chamaemorus* alternating with wet spots with *Sphagnum Lindbergii, S. Dusenii, Carex magellanica* and *Scheuchzeria palustris.* In the tarn are *Menyanthes trifoliata, Carex rostrata, Equisetum fluviatile* and *Nuphar luteum.*

Railway trip Dorotea—Gällivare, 560 km. The railway, "Inlandsbanan," is 1 300 km long and runs through the inner forest and mire lands of North Sweden from Kristinehamn at Lake Vänern to Gällivare in northern Lappland. The last section, between Arvidsjaur and Jokkmokk, was opened for traffic in 1937. From the railway roads lead to small settlements among the mountains where the settlers started only 150 years ago. The forests are coniferous frequently mixed with birch. Hard logging in many places has left its stamp on the forest and in spite of successful reforestation begun in many places, one gets the impression that the forest along the entire railway line is thin and badly mismanaged.

From Vilhelmina to Storuman the railway runs chiefly on the plateau between the rivers Ångermanälven and Umeälven, a district called Mt. Stöttingfjället, the forest-clad tops of which reach heights of 500—700 m above sea level. After Storuman we enter one of Norrland's great pine districts, in many places very rocky but mostly covered with pine on sediment soils. The mires are smaller than those seen earlier in the day. The river Skellefte älv is crossed at the southern point of Storavan, a lake, extending far into the mountains.

After Arvidsjaur the line runs through a typical inner-Norrland district with spruce forests on the watershed and pine

forests next to the rivers. Vast mire lands alternate with the sparse forests. Settlements are rare and mostly of a very recent date, after the building of the railway. In many parts the farms are located to cultivated mire, where a good hay crop is obtained, but barley does not always ripen and it does not pay to grow other kinds of cereals. In many places people still cut the mires which yield, however, only a poor sedge hay.

Immediately before Jokkmokk the Arctic Circle is passed. Around Jokkmokk pine is predominating as also in several places along the road to Porjus. Harsprånget, a waterfall in the river Stora Lule älv, is passed and we reach Porjus. To the east there is a forest and mire area which directly passes into the Muddus National Park. We arrive at Gällivare in the evening. Immediately to the south of Gällivare is Mt. Dundret, 820 m high, the top without forest.

Gällivare and Malmberget with together 8 000 inhabitants are situated in an old settled district where iron ore has been mined more than 200 years. In river boats and in "ackjor" (small boat-shaped sleighs) the ore was transported to the coast. Not until the 1870-ties, a road was built that could be used also during the summer. In the year 1888 the first train with ore went on the "Riksgränsbanan," which then went as far as Luleå and later (1903) was extended to Narvik.

Saturday, 29th July.

By bus 30 km on the way towards Porjus. By foot over the pine heath forest Hapsaheden to the border of Muddus National Park (lat. N 67°).

Muddus National Park is a forest reserve, 49 500 hectares in size, set aside in 1942 on the initiative of Forest Officer Edv. Wibeck. The district has since 1943 been subject to several investigations so far published only in preliminary reports.

The precipitation is about 460 mm, the annual temperature about —0.7° C, the average in July +14° C and in January —12° C.

Little more than half the district is occupied by forest; 40 per cent is mire and the rest water. Spruce forests are predominating in the central, western and northern parts. Untouched pine forests are found chiefly in the eastern part whereas the pine forest in the southern parts has been subject to some cutting in the 1880-ties. The forest and mire land around Lake Muddusjaure in the middle of the park is on the 400 m level. The mountains in the west reach 600—650 m and have tree-less scull-caps; the mountains in the east are lower and forest-clad. In the south part of the park there are several canyons, the deepest, Moskoskorso, 100 m deep, the longest about 10 km long with the river Muddusjokk running in the bottom.

The pine forest near the border is a heath type with the *Calluna*- and *Cladonia*-unions. The 200—300 years old pines grow sparsely and rejuvenation is difficult. Only when a pine has died is it possible for seedlings to find a spot free of competition.

A stop will be made in a spruce forest section with chiefly the *Geranium*- and the *Dryopteris*-unions, and with meadow herb vegetation in places. We find here one of the few stations for *Lactuca alpina*. Through the birch forests we proceed to the summit of Syd-Stubba, from where a good view over Muddus is achieved. Back to the road where it touches the park boundary.

Sunday, 30th July.

By aeroplane to Muddusjaure. The route is laid over the Sjaunja mires, the biggest mire area in Sweden, which form a

real wilderness and in the west reaches the National Parks of Stora Sjöfallet and Sarek, 3 400 sq. km. The planes fly over Porjus and follow the river Luleälv past Harsprånget to the southern part of Muddus; over the canyons and a large area burnt during a forest fire in 1933, and continue along Muddusjokk to Muddusjaure.

Muddusjaure is a 7 km long, very shallow lake with *Nymphaea candida*, *Nuphar luteum*, *N. pumilum* and their hybrid, *Potamogeton perfoliatus*, *P. pusillus* and *P. praelongus*, *Equisetum fluviatile*, *Scirpus lacustris*, *Phragmites communis* and *Menyanthes trifoliata*. *Sparganium angustifolium* is common, *Hippuris vulgaris*, *Myriophyllum alterniflorum*, *Isoëtes lacustris*, and *I. echinospora* as well. On the banks (and also in the water) *Subularia aquatica* and *Ranunculus reptans* grow. The participants walk along the banks of, or paddle in a brook running from the Muddusluobbal-lakes. Assemblage on the neck between these and walk through the forest land.

On the different pine forest types on heath-land will be demonstrated. A pine forest on sand with a sparse field layer of *Calluna vulgaris* and *Vaccinium Vitis-idaea* and a bottom layer of *Cladonia* species and *Stereocaulon paschale* gives interesting examples of rejuvenation problems. The natural forest on these soils is the pine forest thus forming the climax association. The spruce has no chances to grow to the size of a tree here. Single small spruces keep alive during a long time but after perhaps 50 years they still are only about a foot high, and finally die.

Over night in tents in the primeval forest at Mansare, where an old hunters' cottage called "Mansarekojan" has been put in order for the supervision personnel and for minor research parties.

Monday, 31st July.

The primeval forests on Mt. Linahuornats belong to the oldest in the park. On the bouldery soil the *Empetrum*- and *Myrtillus*-union in combination with the *Pleurozium*-union, are prevailing. The pines of the oldest generation are 420—430 years old and have very likely germinated after a forest fire. Evidently, the forest was of uniform density at the end of the 16th century and the ground fully occupied. Only after a forest fire in the beginning of the 18th century, when some pines were killed, new pines could come up. Competition soon again prevented all regeneration and after an interval of 125 years, when some old trees had died, the third of the generations now forming the forest got a start. Some spruce and birch is also found. The present regeneration material grows so slowly because of the severe competition from tree layer and field layer that the snow blight (*Phacidium infestans*), Norrland's most dangerous injurious fungus to pine plants, has time to kill the plants.

Tuesday, 1st August.

The spruce forests on the slopes of Mt. Linavara are partly 300 years old. The *Myrtillus*-union is replaced here and there by the *Dryopteris*-union. This spruce forest is here, as it is in most parts of Norrland, the climax association. The forest fires are hard upon the spruce and favor the pine, which, like *Betula verrucosa*, has the best possibility of coming up in burnt areas. In areas which have had no fires for centuries, the spruce gains at the expense of the pine except in extremely dry places. There *B. verrucosa* disappears, too.

Birch is common on Linavara and shows with regard to species an interesting distribution. In the western and northern slopes only *Betula pubescens* is found. On the top of the plateau

grow *B. tortuosa* and hybrids between the two. On the southern slopes in the pure pine forest *B. verrucosa* occurs.

We continue to Sollaure outside the boundaries of the National Park and to Urtimjaure. By bus to Gällivare.

Wednesday, 2nd August.

Departure by train to Kiruna. The surroundings of Gällivare are rather flat forest and mire districts. The spruce and pine forests gradually become more mixed with birch. Here and there a glimpse of the mountains is obtained. Soon, at Lappberg, the coniferous woods come to an end and the birch-clad land begins. Occasional pine groups are noticed here and there on the hills whereas spruce is getting scarcer.

Kiruna, the world's biggest city with regard to area (13 100 sq. km) includes Jukkasjärvi parish, which stretches from the eastern boundary of Lappland to the Norwegian boundary in the west. Within its limits some of the loftiest mountain peaks in the country are situated, among others the highest, Kebnekaise (2 123 m). The town is situated at the biggest and richest iron ore deposits in Sweden.

Still some distance after we have left Kiruna, pine grows in several places in the birch forest. An isolated occurrence is found at Abisko (see below).

At Torneträsk station the railway reaches Lake Torneträsk which it follows along the mountains on the south side to Abisko.

Thursday, 3rd August.

Through the mountain birch forests in the Abisko valley (see Du Rietz 1950) to Kårsavagge. Here is the northwestern-most occurrence of pine in Sweden. The pines are 200—300 years old and showing an astonishing good growth. The re-

generation is slight, but just at present there is a comparatively great number of seedlings from the 1920-ies and the 1930-ies.

Friday, 4th August, and Saturday, 5th August.

Visit to Björkliden and to Låktatjåkko; see Du Rietz, Excursion Guide.

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